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VIII. *An Account of the Kang, or Chinese Stoves, by Father Gramont, translated from the French.*

Read Jaa. 31, 1770. **T**HE greatest of all masters is want. It is a spur to genius, gives wings to industry, and points out such resources as neither learning nor curiosity would ever have contrived. This it is which has taught the Chinese to make use of sea coal to warm their houses, and to procure to themselves the benefit of its heat without being annoyed by its offensive smoke. This discovery of the Chinese might perhaps be of use in the great city of London, and those parts of England, where this fuel is burnt in rooms. The warm concern the Royal Society has always shewn for whatever affects the lives or welfare of the community, induces us to hope for a favourable acceptance of a model of the Chinese Kang, which we apprehend may be conducive to those beneficent purposes; we therefore have added such explanations as will give an insight into the theory of it, that it may be made known, and improved upon.

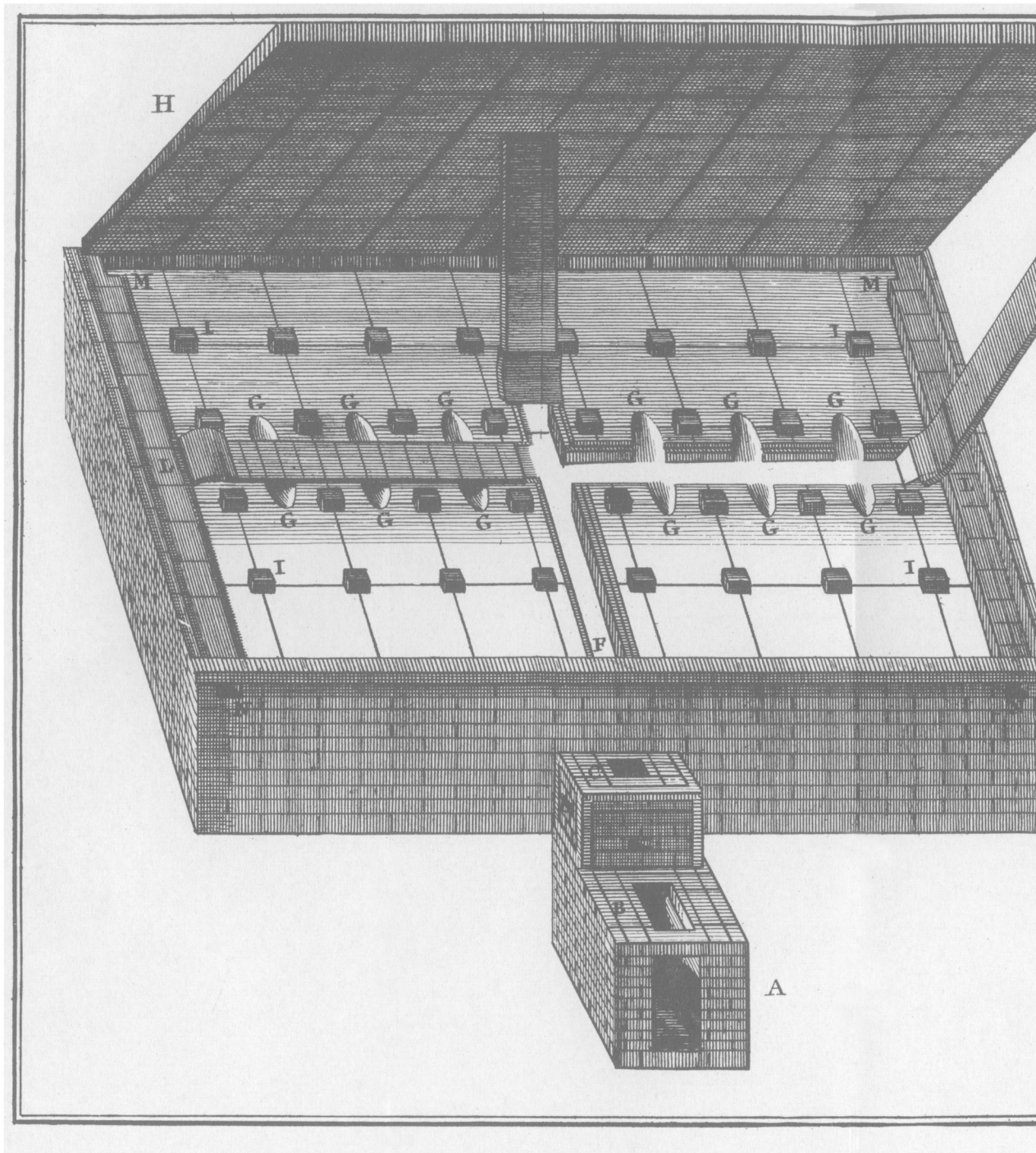
May the illustrious and celebrated Royal Society consider this trifle as a token of our profound respect, and accept it as a small acknowledgement of our gratitude for the favours bestowed upon us, wretched and afflicted as we are! As we have the honour to write to gentlemen eminent for their learning,

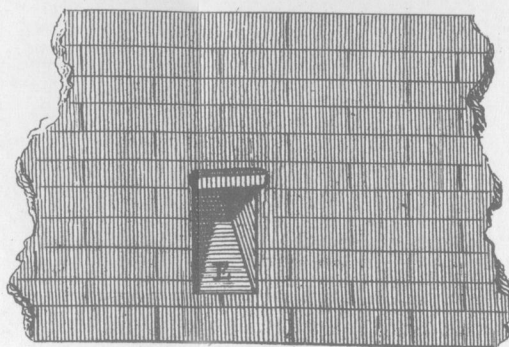
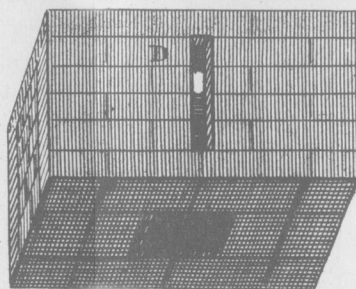
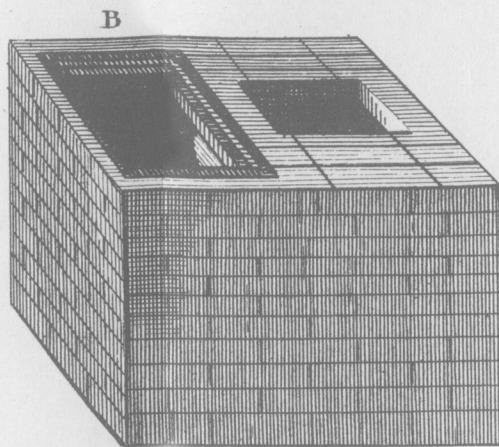
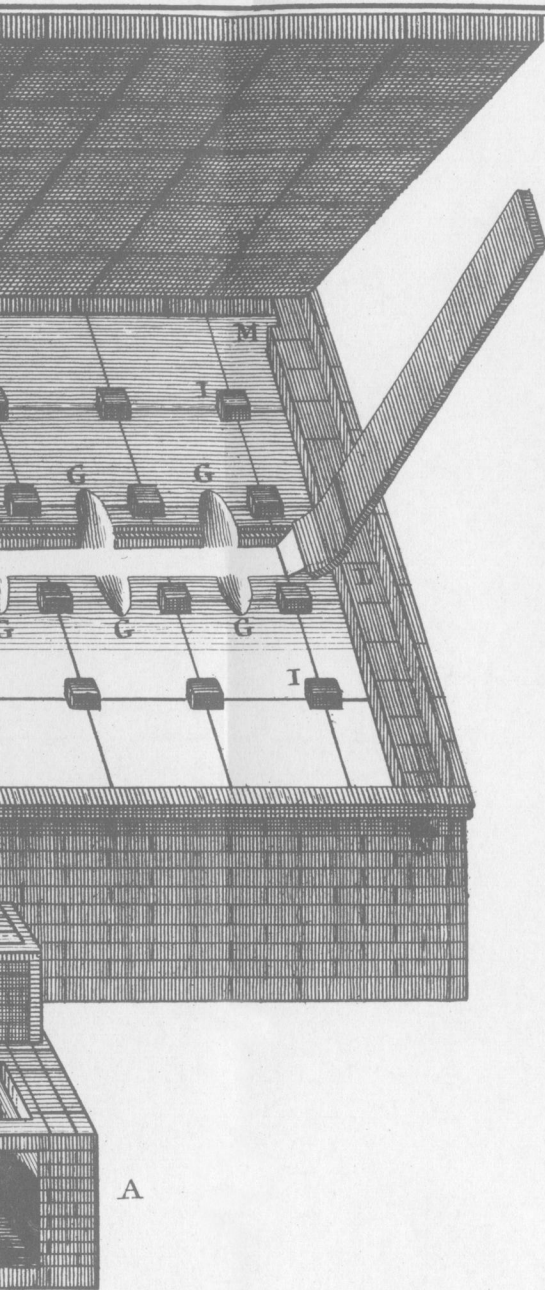
we shall only relate and describe what is most essential.

1. A Kang is a kind of stove, that is heated by means of a furnace, which casts all its heat into it. Many kinds of stoves, ovens, and furnaces, have indeed been contrived beyond sea, which are somewhat like this; but the Chinese seemed to have found means to unite all their conveniences and uses in the Kang. They are of various sorts, the *Kang* with a pavement, or *Ti-Kang*; the *Kang* for sitting people, or *Koa-Kang*; and the chimney *Kang*, or *Tong-Kang*. As they are all made upon the same principle, we shall confine ourselves to the description of the *Kao-Kang*, from which the model (Tab.iii.) is taken.

The parts of a Kang are, 1. a furnace; 2. a pipe for the heat; 3. a brick stove; 4. two funnels for the smoke.

The furnace is proportioned to the size of the stove it is intended to heat. A is the ash hole. B the cellar. C the furnace. D the slit, or mouth, that conveys the flame and heat into the stove. E The pipe or conductor for the heat. F begins at the mouth of the furnace, and forms a channel which falls in a right angle upon a second, that goes quite through under the middle of the floor; and this last pipe has vent holes, G, here and there. The stove is a pavement made of bricks, H, which being supported at the four corners by little solid piles, I, leaves a hollow space between them and the under pavement, where the heat remains pent up, and warms the floor. The smoke funnels are at both ends of the stove L, with a little opening M upon
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the stove, and another N outward, which carries off the smoke.

Nothing can be more simple than the effect resulting from the assemblage of all these parts. The heat of the furnace, impelled by the outward air, and attracted by the rarefied air of the stove, rushes through the slit, ascends into the tube, spreads through the stove by the vent holes, heats the bricks, and from them the whole room. The smoke, which has a free passage, is carried off by the funnels.

2. Admitting this description, which explains the model; let us next consider what is requisite for the construction of a good Kang. The furnace may be placed either in the room itself, or in the next room, or without doors. The poor, who are glad to make the most of the firing that warms the *Kao-Kang*, on which they sit by day, and sleep by night, place the furnace in the same room; the middling sort put it in an adjoining room; the rich and great have it on the outside, and most commonly behind the north wall. The furnace must be much below the level of the stove, that the heat and flame may ascend with the greater impetuosity into the conductor, and not drive up the ashes. The furnace is in the form of a cone, somewhat arched, that the activity of the heat and flame may be all impelled into the stove, and not fly off when the aperture at the top is left open. Note, that the two little moveable slips are planks, that take up occasionally, when people want to go down into the cellar and empty out the ashes. The opening in the furnace is narrow, and the lower end of the conductor must go quick up into the
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stove. The conductor is to be walled in very close on all sides with bricks, and well cemented with mortar made of quick lime. That which the Chinese use is made with one part of white lime to two of black. The black lime, of which we send a sample, is found at the entrance of the coal pits, and seems to us to be no other than coals dissolved by rain waters. We can attest that this substance mixed with white lime makes excellent mortar, nearly resembling cement. It is proof against rain and sun, and is used here to cover and shelter whatever is exposed to the weather. We should rejoice if this hint could prove useful to the British nation. If their country affords black lime, they are possessed of a great treasure.

The ground or flooring of the stove may be of beaten clay, or, what is infinitely better, bricks placed edgewise, or large paving tiles.

The funnel for the smoke, or rather the two funnels, must be made with great care. Some make them terminate in little chimneys, that carry off the smoke above the roof. In the model, they open into the room, as the city poor have them; but in the country, and in gentlemen's houses, they are on the outside.

It is of consequence that the little piles which support the great square bricks of the floor be very solid, and the bricks very thick and perfectly square. The Chinese bind them with a sort of cement made of white and black lime, tempered with *Tong Yeou*, which is a kind of varnish. We are apt to think walnut or linseed oil boiled would do as well.

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As soon as the Kang is compleated, fire is kindled in the furnace, to dry it quick and even. Great diligence must be used in examining it, in order to stop up all the little holes through which the smoke might escape. The wealthy, to make their Kang neater, and to moderate its heat, oil the bricks of the floor, and light the fire, to make the oil penetrate deeper, and to dry them the faster. This oil is again the *Tong Yeou*, and may be supplied with walnut oil.

3. The *Ti Kang*, or paved Kang, is made like the *Kao Kang* just described; the only difference is, 1°, The pipe for the heat goes on rising from the mouth of the furnace to the further end of the room. 2°, It does not communicate with a second pipe, as in the model. 3°, The vent holes that convey the heat into the stove are all made narrow next the furnace, and go widening towards the stove. 4°, The funnels for the smoke always terminate without doors, or end in the little chimneys. 5°, In the Emperor's palace and those of princes, the stove is covered with two rows of bricks, to confine the smoke, and to moderate the heat.

Note, That the bricks in the royal apartments are two feet square, and four inches thick. They cost near a hundred crowns apiece; and are so beautiful, good and solid, that you can have no conception of any such thing beyond the seas. They are grey; but this is owing to the Chinese manner of baking their bricks and tiles, which comes nearer to that of the antients than ours. These bricks when coloured and glazed appear as fine as marble. The

Tong-Kang, or the *Kang* built in the wall, differ from the *Ti-Kang* only by its perpendicular position; the theory is the same.

4. The *Kang* is heated by lighting a fire in the furnace. The smoke and even the flame rushes violently into the pipe, and is carried off by the vent holes all through the stove, where, being pent up, it heats the bricks of the pavement in the space of five or six hours: when a *Kang* is thoroughly heated, very little fire is required to keep it warm, though here the thermometer is almost all the winter at 9, 10, and even 12 or 13 degrees below the freezing point (in Reaumur's thermometer); and although all the rooms are on the ground floor, and have nothing but windows, and those paper windows, all over the front, which is commonly to the south, the warmth of the *Kang* is sufficient to keep up their temperature at 7 or 8 degrees above frost, with very little fire constantly kept up. It seldom rises to more than 4 or 5 degrees in the Emperor's apartments, owing to the double row of bricks, but the warmth is very gentle and very penetrating.

As a *Kang* is heated by a furnace, any kind of fuel will do, *viz.* wood, charcoal, sea coal, furze, &c. The Chinese make the most of every thing. In the palace they burn nothing but wood, or a kind of coal which neither smoaks nor smells, and burns like tinder. The generality of people burn sea coal: the poor in the country make use of furze, straw, cow dung, &c.

A great saving may accrue from the following observation; the Chinese, to save coals, pound them to
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the size of coarse gravel, and mix them with one third, or even an equal quantity, of good yellow clay. This mixture being well kneaden, they make it up into bricks, which strike a greater heat than wood, and come incomparably cheaper. The sea coal thus tempered is far less offensive; and besides, the Chinese, in order to draw off the noisom vapours of the air, constantly heated by the coal fire, always keep bowls of water in the rooms, and renew them now and then. The gold fishes that are kept in these bowls are both an ornament and amusement. In the palace, the Emperor's apartments are decorated with flower pots, and little orange trees, &c. The Chinese philosophers pretend that this is the best way to sweeten the air, and absorb the fiery particles dispersed in it. They likewise leave two panes open night and day at the top of each window, to renew the air, which they think is too much rarefied by the heat. These particulars may appear too trifling to be laid before the Royal Society; but, as they relate to the preservation of their fellow citizens, we hope the worthy members will make allowances in favour of the motive.

5. The Kang is attended with many advantages and conveniencies. 1°, The rich and great are not exposed to the troublesome attendance on a fire in the chimney, and enjoy all its benefits. 2°, The poor use all sorts of fuel without any other expence than what the kitchen requires, and have the comfort of sitting warm by day, and lying warm by night. The fire in the furnace serves to dress victuals, and to heat the stove. The poor go further still: they enclose within the brick work of the Kang a vessel, either

of copper tinned, or of iron, which supplies them with hot water for their tea. This water evaporates in the night, moistens the air of the room, and absorbs the noxious particles of the sea coal. We cannot forbear dwelling upon these little æconomical observations, as our aim is public utility. The Chinese are wont to say, The Emperor can build a palace, and cannot make a shrub; one word from his mouth makes a nobleman of a mere citizen, but all his wishes and prayers cannot prolong the lives of his favourites one single moment.

It is not our part to point out what use might be made of the Chinese Kang beyond the seas; but we apprehend that the *Ti-Kang* might be a profitable improvement for hospitals, manufactories, &c. and a pleasing one for the rich. The *Tong-Kang* properly managed would do very well in upper rooms, and would afford warmth for the bed-chamber, and fire for the dressing-room. The *Kao-Kang* seems less adapted to the customs and manners of Europe, but industry might find some use for it in the country. Should the Kang be rejected on account of its novelty, some hints might still be taken from its construction for the use of several kinds of handicraft.

The Chinese sea coal may give some insight into the formation, qualities, uses, and nature of this singular fossil; but this would require a separate paper. All we shall here observe is, that, as far as we can judge from the samples we have seen, it seems for the most part to be a stone dissolved by the waters, and impregnated with sulphur. Its hurtful qualities proceed from a mixture of antimony, copper, iron, &c.

&c. The best coal, and that which burns fiercest, is glossy, hard and brittle. The Chinese are very fond of that sort that flies, and snaps in the fire, to burn in their forges, because it contains a great deal of salt-petre. When the flame is blue, it is very fierce, but it is too dangerous, as the sulphur is too predominant.

Peking, 22 Oct. 1769.

P. S. If we have expressed ourselves improperly, which would not be very surprizing, considering how little we are versed in these matters, and how little time we can spare for Europe, we are ready to retract whatever may be thought amiss, and to give what further informations may at any time be desired. Whoever has so loved the Chinese for Christ's sake as to come and seek them in this far country, has not divested himself of his attachment to Europe, and will ever be solicitous for the welfare of those he has left behind, and endeavour to promote it, both by their prayers, and imparting whatever may conduce to alleviate the miseries of this short life.

In what a striking light do we here see the vanity of the world, the intoxication of philosophy, and the wretchedness of those who know nothing of Jesus Christ! Learning, vice, and idolatry, go hand in hand in the sanctuary of policy; which knows nothing but the Creator of the world, whom the Chinese worship on their knees, and dishonour in their lives.

As there is room left in the box that contains the model, we have put in some little specimens of sea coal.

N° A. 1, 2, 3, different sorts of sea coal, or rather stones dissolved, and turned to coals.

N° B. 1, 2, sea coal, such as is burnt here. N°. 2 is the best. N° 3. is the same coal turned to black lime. This you may be convinced of, by dissolving it in water, and mixing it with white lime.

N° C. 1, 2, 3, 4, several degrees of bad coal, which produces a dangerous smoke that occasions fainting fits. N° 4. is the worst, and is laid by for the use of forges, whenever it is found.

N° D. is a kind of Clinker, extracted from the ashes of sea coal. That which produces the greatest quantity of it is reckoned the best.

If the Society should be desirous of further informations concerning the sea coal, we must beg to be favoured with particular questions; but let it be remembered, that we are not within reach of such helps as chemistry would afford, nor can elucidate the matter by experiments.